HOLMES (B.)

DISCUSSION OF DR. VAUGHAN'S PAPER.

The Kind and amount of laboratory work which should be required in our medical schools.]

BY

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DISCUSSION OF DR. VAUGHAN'S PAPER.

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Mr. President and Gentlemen of the Association of Medical Colleges.—The paper of Dr. Vaughan, which has interested us so much, suggests great changes in medical education. During the past year my attention has been called to some of the details of laboratory work which must be faced by every one of you. Allow me to very briefly speak of some of the results of my thoughts and studies.

Laboratory rooms must be light and roomy. Forty square feet of floor is the least amount which will accommodate a single student, and then only in the chemical laboratory. In all other laboratories at least sixty square feet of floor space, not including aisles, must be allowed each student. In the chemical laboratory students' desks may be placed twenty feet from the windows; in laboratories in which microscopes are to be used, fourteen feet is a maximum.

The ordinary medical class in the larger institutions ranges from one hundred down to thirty, and therefore the laboratory room should be, if lighted on both sides, not less than fifty by forty feet, and it may be lengthened but not widened. At the institution which I represent, our laboratory rooms were last winter twenty-five feet by sixty feet, lighted on one side and both ends; our largest class numbered

ninety-four, and it was necessary, therefore, except in chemistry and bacteriology, to divide the class into two sections and then crowd them. Our new

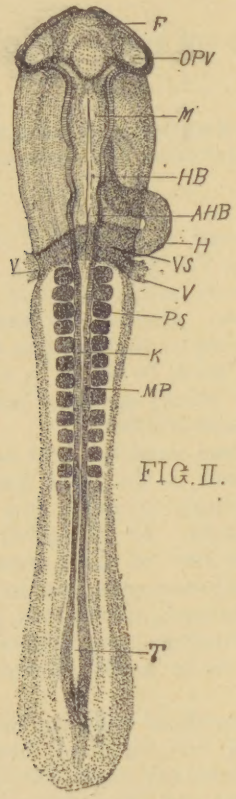


FIG. II.

The Normal Embryo.

laboratories are attached directly to the old ones and are the same width (twenty-five feet), making each laboratory a room 160 feet long, lighted on one side

and capable of accommodating eight students to each ten feet of length. This gives us, besides the necessary reduction for aisles and preparation rooms,

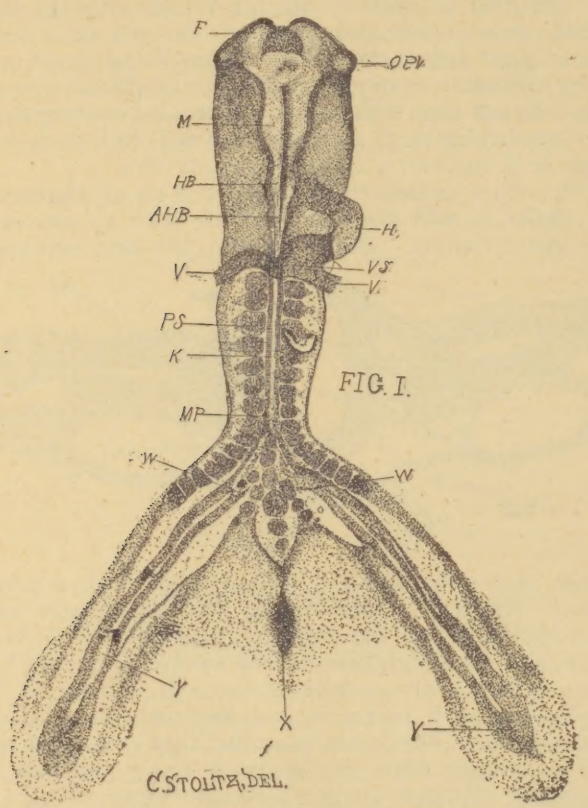


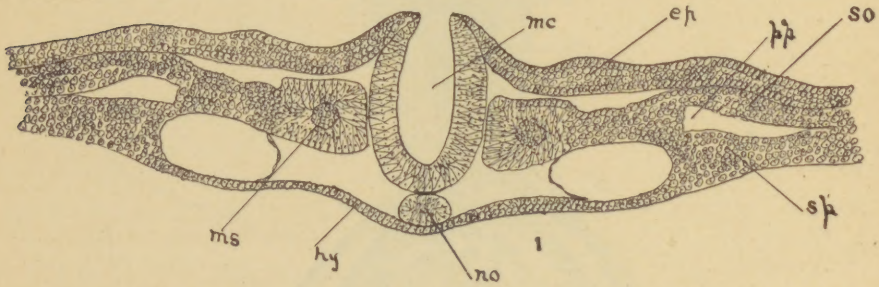
FIG. I.

The Fissioned Embryo.

accommodations for 120 students in each laboratory. This seems like a large class for laboratory work. So it is. And yet the fact that our laboratory teach-

ers are practicing physicians makes it necessary to economize their time. They are unable to give the work the whole day, or every day in the week, and we believe, supposing an unlimited supply, that brick, stone, glass and iron are cheaper than men. This large laboratory class necessitates great and even elaborate system and unusually efficient teachers. Every man who can conduct a laboratory exercise creditably with a class of ten will not be able to hold and instruct a class of seventy-five.

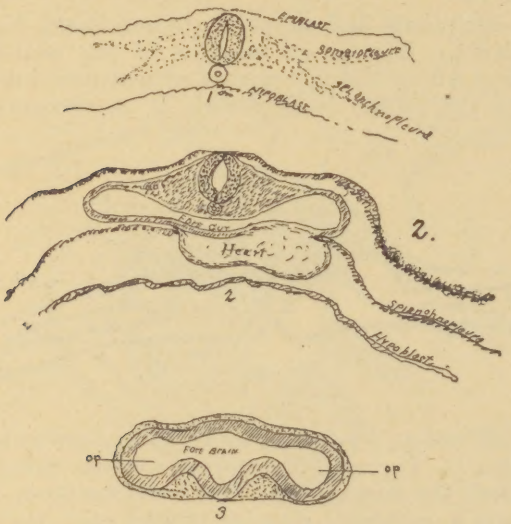
The order necessary requires such an arrangement of desks as will allow two sets of men to use each laboratory room. Our desks in the microscopical



room have a flat surface 1½ by 3½ feet, of oiled white wood. There is a knee space two feet nearly, and two cupboards on the right, each locking with a Yale lock, and each eighteen inches square and two feet deep, in which are suitable drawers and shelves. The desks are built in pairs, and the sides are stained white wood. Stools are provided that are about two inches higher than the ordinary chair, and can be placed in the knee space when not in use.

These details may be tiresome, but success in the laboratory work depends on the care with which these details are considered. One of the most important matters is the system of bookkeeping employed by the curator in keeping track of the supplies. We

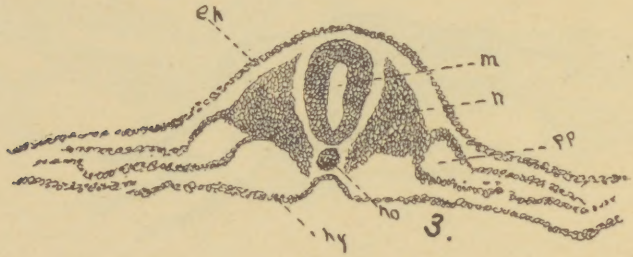
lost at least two thousand dollars unnecessarily from the neglect of this business-like forethought. Last term we started out with a single man for curator. The demonstrators furnished lists of material required for each of the nine laboratory courses which were conducted last term. A sufficient number of outfits were made up by the curator a month before the term opened. On an appointed hour the students selected their desks in the laboratory in the order in



which they purchased their tickets. They went one by one to the store-room as their places were assigned and received each his outfit. In the outfit were two printed lists of the material contained. Each student compared his invoice with the outfit, signed the receipt on one invoice, left it with the curator, and after locking the desk put his key in his pocket and went out in an orderly manner. These receipted invoices were entered in a book which had two col-

umns opposite each student's name, one for debits, one for credits, and a place for the student to sign his name on receiving his balance and closing the account. Students are encouraged to keep their outfits, as they are useful in promoting after study. They are paid for at cost, or a little above cost, out of a deposit fund placed with the treasurer for that purpose. By such a system the laboratories may be made a source of income, and not an expense to the college.

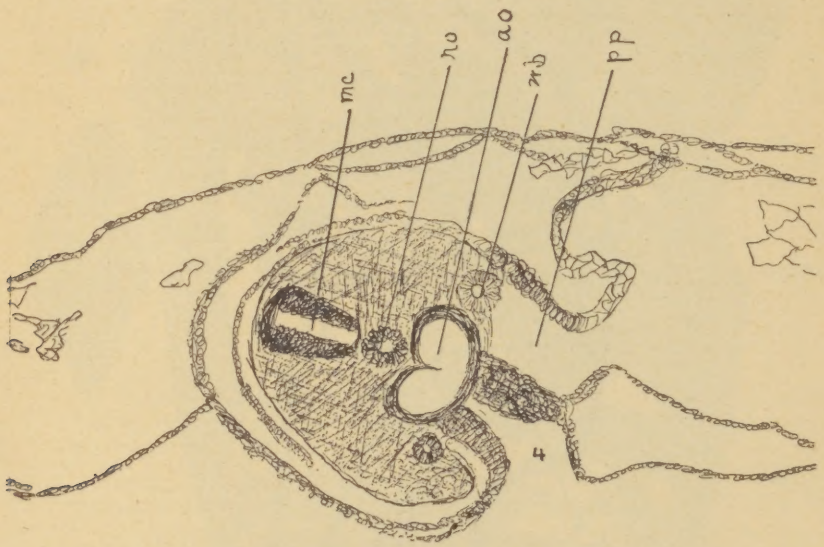
The equipment and supplies are purchased for the most part in Europe, on account of the enormous reduction which the law allows educational institutions in the rebate in imposts. It is necessary to



put in all orders for European goods at least as early as March 1. In our laboratories we are using the Leitz and the Bausch and Lomb microscopes. We have now a sufficient number to give each man an instrument. We urge students to provide themselves with microscopes, and many of them do, especially the second year.

If I may be allowed the time, I should like to show you some drawings made last winter by second year men in the College of Physicians and Surgeons, in the laboratory of Dr. A. P. Ohlmacher, Professor of Embryology and Biology. These 250 or more drawings represent the work of *every one* of the class of

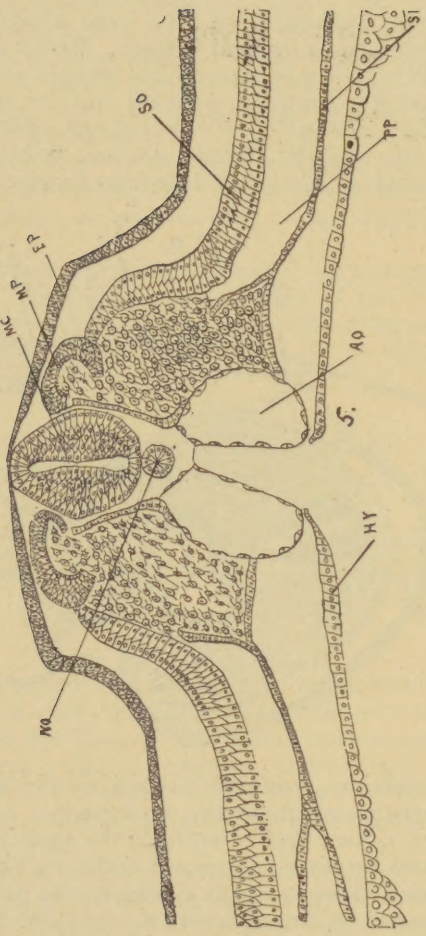
seventy-two students, and they were a part of the final examinations on that branch. Under the directions of Prof. Ohlmacher and his two assistants, Mr. Stolts and Mr. Osincup, selected out of the class, each student opened his incubated egg, sketched and removed his embryo, fixed, stained, imbedded, cut and mounted it. He made drawings representing the



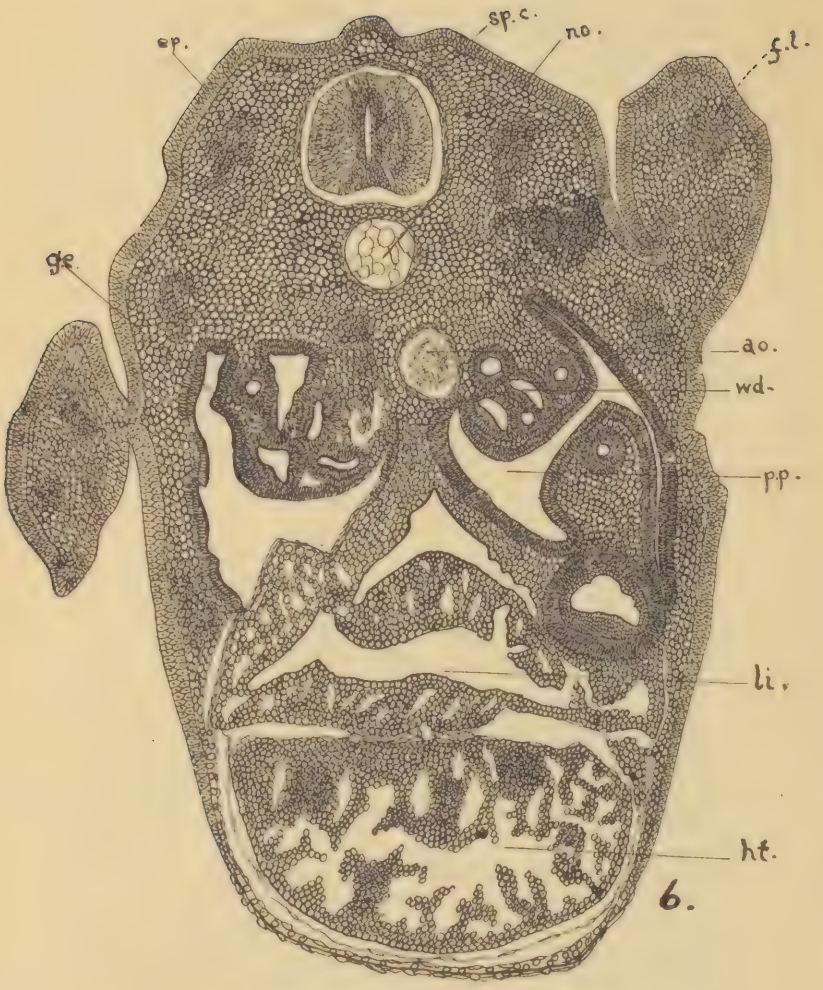
different portions, and was quizzed on the drawings and the specimens under the microscope.

You will notice that in spite of the fact that there is a general impression among students that some cannot draw, there is not one disgraceful drawing in the lot, and there are at least two or three drawings from each student in a class of seventy-two. The class only studied the first four days of the embryo's development, so you will recognize all the parts.

Let me call your attention especially to the draw-



ing of the whole embryo by Mr. Stoltz. Each student made a sketch like this, but Mr. Stoltz, in examining a large number of eggs, found one with an error of



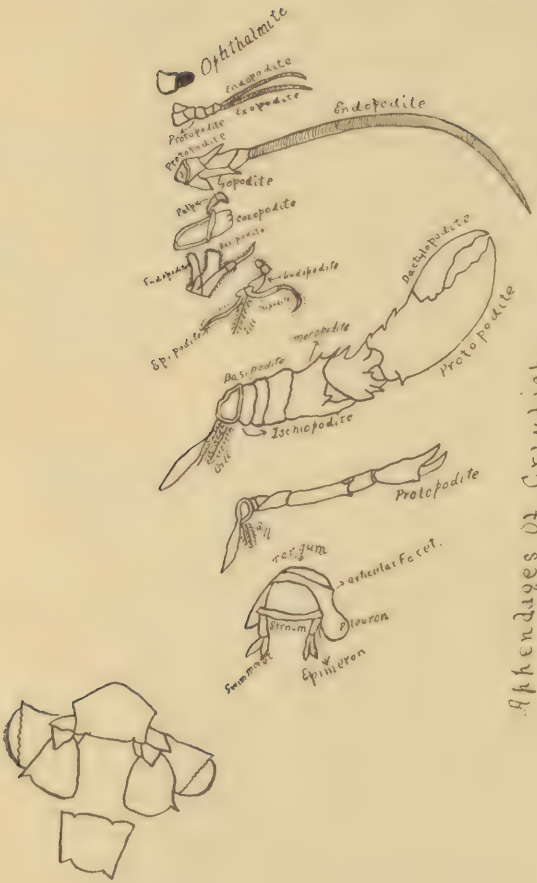
6.

development which he has described in full in the *Scalpel*, the magazine published by the students of the college. Both drawings are reproduced here to show the best free-hand drawing, without the use of a camera lucida or other projection device.

Perhaps the only original departure made by the College of Physicians and Surgeons during the past year has been in the introduction of an extended course in Biology. This course really covers a course in comparative anatomy, a course in elementary physiology, and a course in the histological study of the elements of mammalian structure. As a whole, the course occupies ten hours a week, and has been most successfully conducted by Prof. Ohlmacher. If it will not tire you too much, allow me to show you some 300 drawings made during the present spring term by a class of twenty-two men who have just begun the study. The complete work of each man, as far as has been required, is before you. You will notice a greater difference in the mechanical execution here than in the embryology. The drawings in all the laboratories are made on paper furnished at cost by the College. It is of uniform size, 11 by 8½ inches, or 8½ by 5½ inches. The drawings occupy a definite portion of the sheet, leaving a margin of one inch all around, and a quarter of an inch more on the left hand end for binding. It is impossible to show this work on the printed page, but a few drawings will be reproduced by the photographic process, much reduced, in order to give a faint idea of the work. Some of the best drawings are in colors and cannot be reproduced at all, others are too fine to stand reduction, and others have some shading which would require too expensive a method of reproduction.

Dr. Vaughan has given me one idea which is new, and that is of the position of bacteriology in the course. This branch has been placed in our schools in the third year, on account of its intimate connec-

B. C Grout



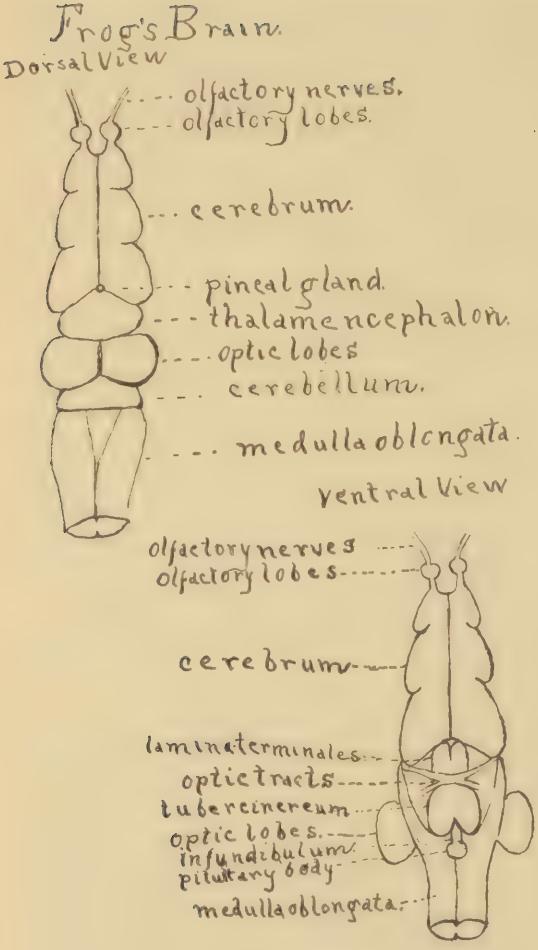
Appendages of Crayfish

tion with medicine and surgery, which fills the fourth year. There seems no reason why it should not appear earlier in the course. Systematic bacteriology could certainly be placed in the second year. Still, I believe that its value to the student would be increased by associating it with pathological study as we have done.

In regard to the length of laboratory hours, several points must be considered. Microscopical laboratories cannot conflict, because we do not have enough microscopes to equip two laboratories at once. Our men cannot spare more than three hours at a time out of their practice, and therefore it has been found necessary with us to make the length of each laboratory exercise two hours. There is no doubt that, had we the entire time of our laboratory teachers at our disposal, it would be better to make the unit of the laboratory exercise three or four hours, as the essayist has suggested.

On account of the necessity of one laboratory exercise following another without intermission, and on account of the necessity of some preparation in each laboratory room before each exercise, we have concluded that it is necessary to provide *at least* two microscopical laboratories. This we have done, and you will see by the time card how our exercises follow one another, and what portion of the student's time in each year's work is occupied in lectures and recitations, in laboratory work and in clinics.

The introduction of laboratory work gives a new impetus to medical education in small cities. The work in this department can be done better, other things being equal, in small medical schools. I predict that these medical schools in small cities that adopt vigorous methods of laboratory teaching will rise to a prominence they could never have attained while medicine was taught by lectures and clinics alone.


Frog's Brain.
Dorsal View
olfactory nerves.
olfactory lobes.
cerebrum.
pineal gland.
thalamencephalon.
optic lobes
cerebellum.
medulla oblongata.
Ventral View
olfactory nerves
olfactory lobes
cerebrum
lamina terminales
optic tracts
tuber cinereum
optic lobes.
infundibulum
pituitary body
medulla oblongata.

J. C. Flemming.

The laboratory teaching will also make a change in the character of medical students. The farmer or butcher medical student cannot hold his knees fifteen or twenty hours a week under the laboratory table throughout a four-year course. He will give place to the educated young men of 20, graduated now in such astounding numbers from the multiplying colleges all over the country, but especially the Central States. It should be our aim to secure these men, if we would have our efforts in medical education succeed.

Again, in order to have our laboratory work done in a constantly efficient manner, it must be done by the same men for a long time. This requires money, and more money than any but the largest schools can obtain from students. That is to say, laboratory work calls for endowment. Only a few State Universities pretend to support medical schools, and so far as I know only one of these, Minnesota, contributes liberally to the annual expenses of the medical department. It seems strange that the department of the university, which should in this country furnish one-fourth of the entire enrollment, should not have received even 2 per cent. of the endowment. It should be the concerted effort of this Association to educate the generous public to a thorough understanding of our deserts and our needs.

The accompanying figures, numbered 1, 2, 3, 4, 5 and 6, represent reproductions of embryological drawings by several of the students in the class. They are all drawings of cross sections of embryo chicks of various stages of development. These drawings were made on the paper described in India ink, being copies of the class-room drawings which were first made in a note book with lead pencil. No text-book was used in the work of embryology, the work being guided by a few printed syllabi and by oral instruction. Hence the student had no illustration of the

object he studied, save the picture his mind conceived. We may, therefore, take these drawings as representing the student's individual conception. The lettering of the various parts is made uniform only for the sake of easy comparison.

Fig. 1 was drawn by Mr. J. F. Adams from a section of the tail end of a 36-hours chick. It shows very clearly the primitive germinal layers, splitting of the mesoblast, mesoblastic somites, notochord and medullary canal not completely closed. Fig. 2 represents three drawings by Mr. O. B. Monosmith, showing a section through the tail end, one through the heart region and one through the fore brain of a 36-hours chick, all from the same embryo. Fig. 3, from an embryo of about 50 hours incubation, by A. M. Fulton. Fig. 4 shows the amniotic folds and amniotic cavity very clearly, and was drawn by Mr. G. A. Hibbert. Fig. 5 is from a section through the hind end of a 3-days chick, by Mr. R. H. Herrold. Fig. 6 was drawn from a section of a 5-days chick, by Mr. J. J. Pierron, and shows the budding of the fore limbs, the development of the heart, liver, urogenital system, etc.

To anyone who has had experience in this kind of work it must be evident that many hours of painstaking labor have been spent in producing some of these drawings.

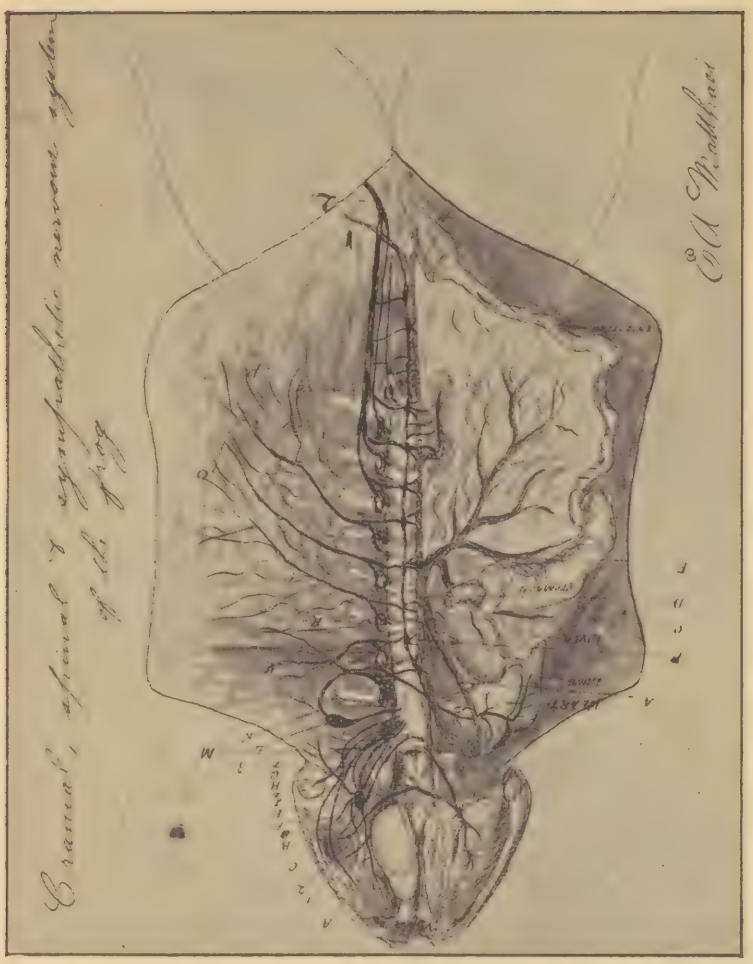
The few drawings of the spring class in biology here reproduced speak for themselves. They are copies of note book drawings made by the student as he dissected the animal chosen. Huxley and Martin's Practical Biology was used as a guide in the work on the crayfish and frog, and one familiar with this most valuable laboratory guide will know that it contains no figures of the dissections prescribed. Therefore, in this work, as in the course in embryology, the drawings are the student's representation of what he saw as he made his dissections.

Moreover, this work of reproducing the curves, elevations and depressions, distinctions between organs, etc., of the *whole object*, is much more difficult than the reproduction of microscopical sections, as every scientific draughtsman knows.

In the biological class each student caried out his own work. He made all the dissections, injections and other preparations required, himself, and then made a drawing of the completed work which he copied on the sheets of paper furnished, either in India ink or in color. It will be noted that some of the work is plain outline drawing, while more ambitious students have shaded and colored their drawings most artistically.

Is it not reasonable to presume that a man who has dissected and verified all the intricate and minute relations of the cerebro-spinal and sympathetic nervous systems of the frog will go to his human subject with a determination of carrying out equally exacting studies? We believe that a student who has by his own labor produced such a drawing as that made by Mr. Matthaei of the cerebro-spinal and sympathetic systems, will be a credit to himself and to his teachers in any more purely medical study.

Will not Mr. Fleming approach his studies on the human brain with a more lively interest and a broader foundation for having dissected and drawn this frog's brain? The subject of human osteology will lose some of its proverbial dryness for Mr. Mueller since he has made his picture of the frog's skeleton and since he became familiar with the bones of the frog's cranium, some of which are no larger than the letters of this type. The myology of the human leg will have no terrors for Mr. Clapp who has so scientifically dissected and artistically represented the leg muscles of the frog. Mr. Grout will better appreciate the mechanism of a man's joints from having studied the appendages of a crayfish.

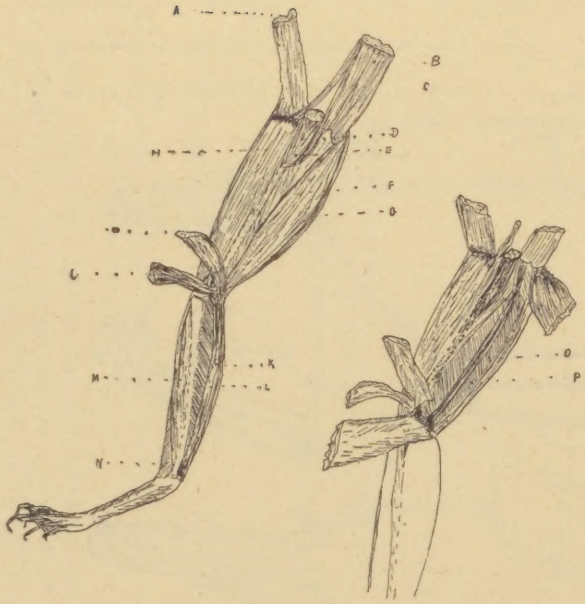


Muscles of the thigh & leg

Ventral aspect.

E. A. Matthaei

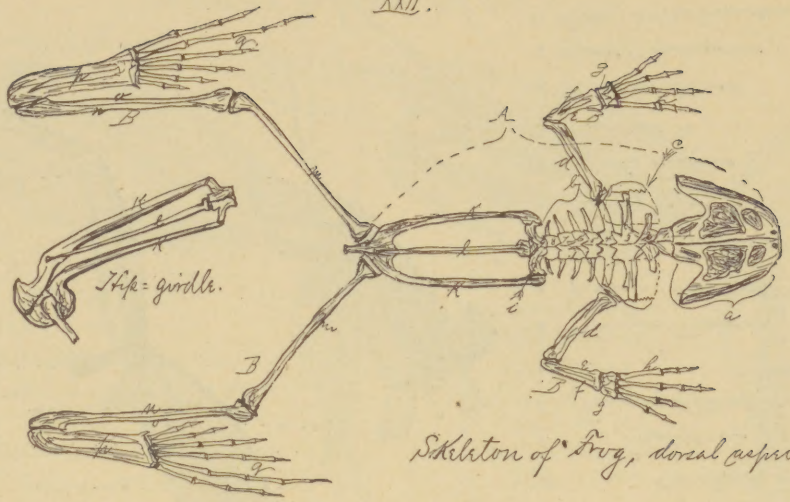
Leg Muscles.



A Cut end of Sartorius
B " " Adductor Magnus
C " " " " Longus
D Adductor Brevis
E Pectineus
F Rectus Anticus Major
G " " " Minor
H Triceps Femoris
I Lower end Adductor Magnus
L " " " Sartorius
K. Gastrocnemius
L. Tibialis Posticus
M Peroneus
N. Peroneus Brevis
O Semi-Tendinosus
P. Semi-Membranosus.

H. D. Clapp

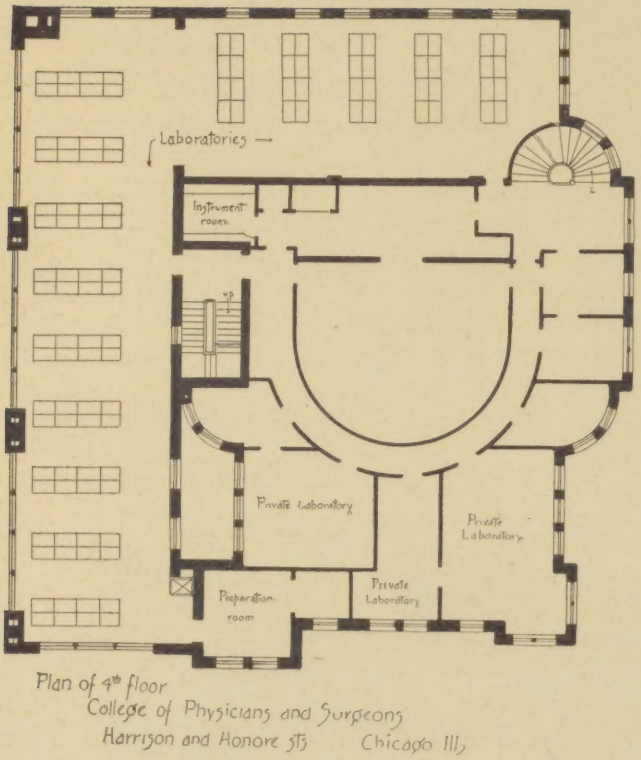
XXII.



Skeleton of Frog, dorsal aspect.

A. axial, B. appendicular skeleton. - a. head, b. vertebrae (9) c. shoulder girdle, d. humerus, e. radius, f. ulna, g. carpus, h. digits. i, 9th vertebra or sacrum, K. hip girdle or pelvic arch, l. prootyle, m. femur, n. tibia, o. fibula, p, tarsus, q. digites.

F. L. Mueller, May 1892.



THE LABORATORIES OF THE COLLEGE OF PHYSICIANS AND SURGEONS, CHICAGO.

The above cut is a plan of the fourth floor of the college building as it now stands. The front and south side of the building is down. The laboratory is L-shaped, and 100 feet long on the west, 56 feet on the north. It is now fitted up for one hundred and twelve students.